I claim:

1. A process which comprises polymerizing an olefin in the presence of: (a) a single-site or Ziegler-Natta olefin polymerization catalyst; (b) a low-temperature, platinum-group dehydrogenation catalyst; and (c) an optional hydrocarbon solvent, under conditions effective to promote:

   (i) olefin polymerization;

   (ii) catalytic dehydrogenation of the solvent and/or the resulting saturated oligomer or polymer chains to produce short and/or long-chain alkenes; and

   (iii) copolymerization of additional olefin with the alkenes;

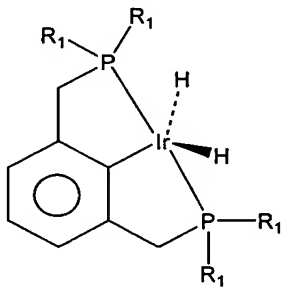
   to produce a polyolefin having long-chain branching and/or a density less than about 0.96 g/cm^3.

2. The process of claim **1** wherein the low-temperature dehydrogenation catalyst contains a transition metal selected from the group consisting of nickel, palladium, platinum, iridium, rhodium, ruthenium, and rhenium.

3. The process of claim **2** wherein the transition metal is iridium.

4. The process of claim **1** wherein the dehydrogenation catalyst is a pincer complex.

5. The process of claim **4** wherein the dehydrogenation catalyst has the general structure:

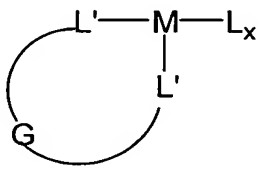


in which each R_1 is independently a C_1-C_{30} hydrocarbyl radical.

6. The process of claim **1** wherein the olefin polymerization catalyst comprises an activator and an organometallic complex, wherein the organometallic complex comprises a Group 3 to 10 transition metal, M, and at least one polymerization-stable anionic ligand that is bonded to M.

7. The process of claim **6** wherein the organometallic complex has open architecture.

8. The process of claim **6** wherein the organometallic complex has the general structure:



wherein M is a Group 3 to 10 transition metal; each L is independently selected from the group consisting of halide, alkoxy, aryloxy, siloxy, alkylamino, and C_1-C_{30} hydrocarbyl; each L' is independently selected from the group consisting of alkylamido, substituted or unsubstituted cyclopentadienyl, fluorenyl, indenyl, boraaryl, pyrrolyl, azaborolinyl, and indenoindolyl; G is a linking group and x satisfies the valence of M.

9. The process of claim **8** wherein G is a divalent radical selected from the group consisting of hydrocarbyl and heteroatom-containing alkylene radicals, diorganosilyl radicals, diorganogermanium radicals, and diorganotin radicals.

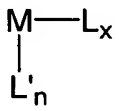
10. The process of claim **9** wherein one L' is alkylamido and the other L' is selected from the group consisting of substituted or unsubstituted cyclopentadienyl, fluorenyl, indenyl, and indenoindolyl.

11. The process of claim **6** wherein the polymerization-stable anionic ligand is selected from the group consisting of cyclopentadienyl, indenyl, fluorenyl, and indenoindolyl ligands.

12. The process of claim **6** wherein the Group 3 to 10 transition metal is a Group 4 transition metal.

13. The process of claim **6** wherein the activator is selected from the group consisting of alumoxanes, alkylaluminum compounds, organoboranes, ionic borates, ionic aluminates, aluminoboronates, and mixtures thereof.

14. The process of claim **6** wherein the organometallic complex has the general structure:



wherein M is a Group 3 to 10 transition metal; each L is independently selected from the group consisting of halide, alkoxy, aryloxy, siloxy, alkylamino, and C_1-C_{30} hydrocarbyl; each L' is independently selected from the group consisting of alkylamido, substituted or unsubstituted cyclopentadienyl, fluorenyl, indenyl, boraaryl, azaborolinyl, and indenoindolyl; n is 1 or 2 and x satisfies the valence of M.

15. The process of claim **1** wherein the olefin is selected from the group consisting of ethylene, propylene, 1-butene, 1-pentene, 1-hexene, 1-octene, and mixtures thereof.

16. The process of claim **1** wherein the olefin is ethylene.

17. The process of claim **1** wherein the polymerization is performed at a temperature within the range of about 30°C to about 250°C.

18. The process of claim **1** wherein the polymerization is performed at a temperature within the range of about 30°C to about 160°C.

19. A gas-phase, slurry, or solution process of claim **1**.

20. A polyolefin made by the process of claim **1**.

21. The polyolefin of claim **20** wherein the olefin consists essentially of ethylene.